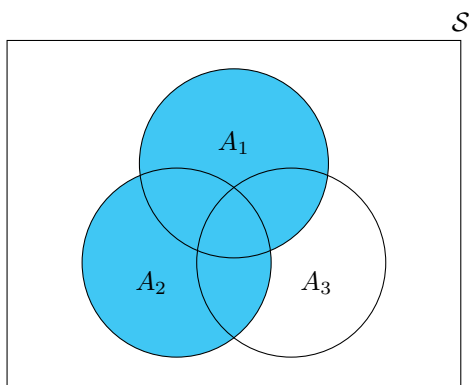We have $P(A_1) = 0.22$, $P(A_2) = 0.25$, $P(A_3) = 0.28$, $P(A_1 \cap A_2) = 0.11$, $P(A_1 \cap A_3) = 0.05$, $P(A_2 \cap A_3) = 0.07$, and $P(A_1 \cap A_2 \cap A_3) = 0.01$.
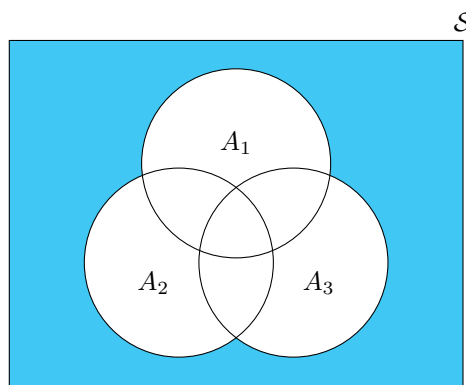
a. $A_1 \cup A_2$

$$P(A_1 \cup A_2) = P(A_1) + P(A_2) - P(A_1 \cap A_2)$$
$$= 0.22 + 0.25 - 0.11 = 0.36$$

b. $A_1' \cap A_2'$

$$P(A_1' \cap A_2') = 1 - P(A_1 \cup A_2)$$
$$= 1 - 0.36 = 0.64$$

c. $A_1 \cup A_2 \cup A_3$

$$P(A_1 \cup A_2 \cup A_3) = P(A_1) + P(A_2) + P(A_3)$$
$$- P(A_1 \cap A_2) - P(A_1 \cap A_3) - P(A_2 \cap A_3)$$
$$+ P(A_1 \cap A_2 \cap A_3) = 0.53$$

d. $A_1' \cap A_2' \cap A_3'$

$$P(A_1' \cap A_2' \cap A_3') = 1 - P(A_1 \cup A_2 \cup A_3)$$
$$= 1 - 0.53 = 0.47$$
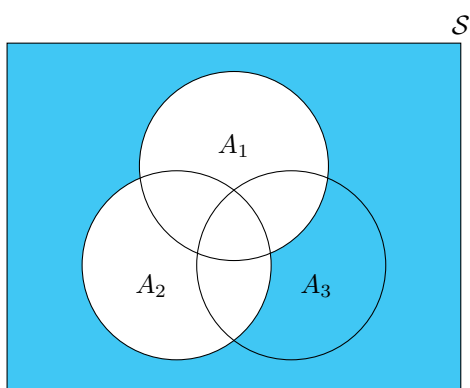
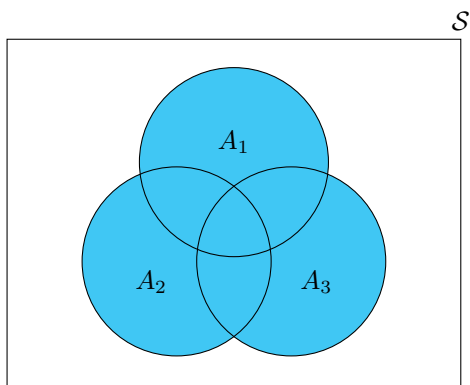**e.** $A_1' \cap A_2' \cap A_3$

$$P(A_1' \cap A_2' \cap A_3) = 1 - P(A_1 \cup A_2 \cup A_3')$$
$$= 1 - [P(A_1 \cup A_2) + P(A_1' \cap A_2' \cap A_3')]$$
$$= 1 - [0.36 + 0.47] = 0.17$$

f. $(A_1' \cap A_2') \cup A_3$

$$P((A_1' \cap A_2') \cup A_3) = P(A_1' \cap A_2') + P(A_3)$$
$$- P(A_1' \cap A_2' \cap A_3) = 0.64 + 0.28 - 0.17 = 0.75$$